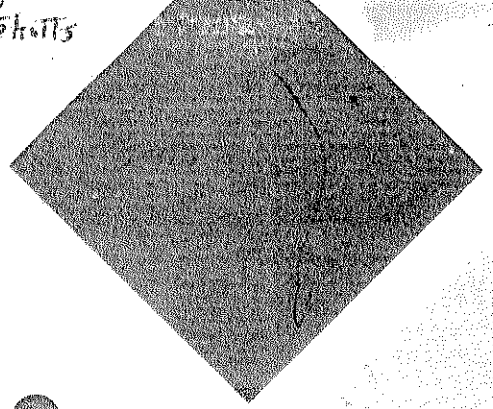

EDUCATION SERVICES

STERILIZATION AIDS

Prepared by the
Education Division of
AMSCO/American Sterilizer Company
Erie, Pennsylvania

Better Patient Care Through Education

AMSCO
AN EMPLOYEE OWNED COMPANY

PRESSURE STEAM STERILIZATION

Preparing the Load

1. Use freshly laundered 140 thread count muslin (or equivalent).* This helps prevent superheating and provides longer life of the textiles.

2. Limit the size and density of each muslin pack. This helps ensure complete steam permeation, and provides a liberal margin of safety for sterilization. Limiting the size and weight is also necessary for drying.

STANDARDS OF MUSLIN PACK PREPARATION

Maximum Size ..... 12" W x 12" H x 20" L
Maximum Weight ..... 12 lbs.
Maximum Density** ..... 7.2 Pounds Per Cubic Foot

**PACK DENSITY FORMULA

Step #1

$$\frac{\text{Size of Pack (expressed in inches)}}{1728^{1}} = \text{Cubic Feet of Pack}$$

[1]1728 is the number of cubic inches in a cubic foot.

Step #2

$$\frac{\text{Weight of Pack}}{\text{Cubic Feet of Pack}} = \text{Density Factor (pounds per cubic foot)}$$

Examples of how to obtain density factor:

EXAMPLE #1

USING A STANDARD 12x12x20" PACK WEIGHING 12 POUNDS

Step #1 $\frac{12x12x20"}{1728} = \frac{2880}{1728} = 1.666$ cubic feet

Step #2 $\frac{12 \text{ Pounds}}{1.666 \text{ cubic feet}} = 7.2$ pounds per cubic foot

EXAMPLE #2

USING A STANDARD 3x7x15" PACK WEIGHING 7 POUNDS

Step #1 $\frac{3x7x15"}{1728} = \frac{315"}{1728} = .1822$ cubic feet

Step #2 $\frac{7 \text{ Pounds}}{.1822 \text{ cubic feet}} = 38.419$ pounds per cubic foot

No pack should have a density factor in excess of 7.2 pounds per cubic foot.

3. Limit the size and weight of wrapped instrument set. Maximum weight is 17 pounds. Instruments should be dry and placed into a mesh bottom (or its equivalent) tray. A single layer (open) huck towel in bottom of tray can assist in drying phase of cycle.

4. Do not stack or nest utensils unless they are separated by muslin. Bottoms of utensils should be parallel. The weight of each utensil set should not exceed 7 pounds.

5. Use two double-thickness 140 thread count muslin (or equivalent)* as wrapping material for the item(s) to be sterilized. The two wrappers should be applied sequentially. This provides protection after sterilization and permits aseptic practice in opening.

**Muslin wrappers of 140 thread count are the standard upon which recommendations are made for steam sterilization. The manufacturer of other material should show data that indicates his product is equivalent to the muslin profile in steam sterilization. Extended drying time may be necessary for the non-strike through materials — woven/non-woven.*

Loading Steam Sterilizer (Shelves or Loading Car)

1. Place all textile packs/packages on edge and arrange load in chamber to allow minimal resistance to steam passage through load.

2. Place treatment trays on edge — with longest side on shelf.

- When assembling, place basin, cup, medicine glass (solid bottom container), etc. that may be included in contents in a position so that it will not trap air and condensate during sterilization.

NOTE: When sterilizing any container, imagine it filled with water, then place it so that the water would drain out freely.

3. Place utensils on edge, tipped slightly forward, so they will be sterilized and dried properly.

4. Place instrument set in tray having mesh bottom (or equivalent) flat on shelf for sterilization. A properly designed tray is necessary for sterilization and for drying when using a wrapped technique.

5. In mixed loads, combining fabrics and hard goods, place the hard goods on lower shelves. This prevents wetting of fabrics from condensate dripping from hard goods.

6. Place paper/plastic peel pouch type packages on edge with plastic side of one facing paper side of the next — paper side facing slightly downward to prevent entrapment of moisture.

7. DO NOT OVERLOAD STERILIZER. Load shelf loosely (do not compress packages).

8. Do not allow load components to contact the sterilizer chamber walls.

9. Provide at least 3 inches between the chamber ceiling and the topmost package of the load.

10. Never place packages on chamber floor.

11. STERILIZE LIQUIDS SEPARATELY from other supplies or materials.

WARNING
LIQUID STERILIZATION

To prevent possible personal injury or property damage resulting from bursting bottles and hot fluid, you must follow the recommended procedure listed below:

RECOMMENDED PROCEDURE

- Use only self-venting closures — do not use screw caps or rubber stoppers with crimped seal.
- Use only Type I borosilicate glass bottles — do not use ordinary glass containers not designed for sterilization or resterilization.
- Use sterilizer "Liquids" cycle. No other cycle is safe for liquid sterilization.
- At end of cycle, open sterilizer door no more than 1/2 inch. Wait 10 minutes before unloading sterilizer.
- Do not allow hot bottles to be jolted. This can cause hot-bottle explosions! Do not move bottles if any boiling or bubbling of fluid is present.
- Bottles should be cool to touch before attempting to move them from sterilizer loading car or shelves to the storage area.

12. The following list is intended as a guideline only. PRODUCT AND EQUIPMENT MANUFACTURER'S MANUALS SHOULD FIRST BE CONSULTED FOR SPECIFIC INSTRUCTIONS RELATING TO EQUIPMENT, TIME, TEMPERATURE, AND DRYING RECOMMENDATIONS.

EXPOSURE PERIODS FOR STEAM STERILIZATION OF SPECIFIC ARTICLES*

Article	Minimum Time Required (in minutes) Sterilizer Type and Temperature	
	Gravity 250-254 F (121-123 C)	Gravity 270-274 F (132-134 C)
Brushes, synthetic fibers, in dispensers or individually wrapped	30	15
Dressings, wrapped in muslin or equivalent	30	15
Fluids (Square-Pak bottles)**		
75 ml.	25	
250 ml.	30	
500 ml.	40	
1000 ml.	45	
1500 ml.	50	
2000 ml.	55	
Glassware, empty, inverted, **unwrapped**	15	3
Instruments, metal only, in mesh bottom tray, **unwrapped**	15	3
Instruments, metal, in mesh bottom tray, combined with suture, tubing, or other porous materials, **unwrapped**	20	10
Instruments, metal only, in covered or padded mesh bottom tray	20	10
Instruments, metal, combined with other porous materials in covered or padded mesh bottom tray	30	15
Instruments, in mesh bottom tray, wrapped in 2 double thickness muslin or equivalent	30	15
Muslin pack (maximum size: 12x12x20", maximum weight: 12 lbs., maximum density 7.2 lbs. per cubic foot)	30	
Needles, hollow, lumen moist, individually packaged	30	15

Continued

Rubber catheters, drains, tubing, (lumen moist), **unwrapped**	20	10
Rubber catheters, drains, tubing, (lumen moist), individually packaged	30	15
Treatment trays, wrapped in muslin or equivalent**	30	15
Syringes, disassembled, individually packaged	30	15
Syringes, disassembled, **unwrapped**	15	3
Utensils, on edge, **unwrapped**	15	3
Utensils, on edge, wrapped in muslin or equivalent**	30	15

**Reference Principles and Methods of Sterilization in Health Sciences — Perkins 1969*

***Denotes 1981 AMSCO research information.*

THE RECOMMENDED EXPOSURE TIME FOR PRE-VAC STEAM STERILIZER IS FOUR (4) MINUTES AT 270-274°F (132-134°C).

Unloading the Steam Sterilizer

1. Biobarrier (wrapper/packaging material) should be dry upon removal from sterilizer.

2. Upon removal of the loading car from the sterilizer, it should be placed where there are no air conditioning or other cold air vents in close proximity.

3. Sterilized items should remain on loading car and not be handled until contents have reached ambient room temperature. Depending on items and environment of area, this may take approximately from 1 to 3 hours.

Caring for Steam Sterilizer

Daily:

1. Wash sterilizer chamber, using a mild detergent solution such as Calgonite®*. Never use strong abrasives, steel wool, etc. A long-handled cellulose sponge mop is helpful in cleaning the longer chambers. CHAMBER SHOULD BE COOL BEFORE CLEANING.

***NOTE:** A clean chamber can help prevent wet pack problems because dirt acts as an insulator.

2. Rinse sterilizer chamber with tap water.

3. Dry sterilizer chamber with lint-free cloth(s).

4. Remove chamber drain strainer and free from lint, sediment, etc. — replace.

5. Wash sterilizer shelves or loading car and carriage.

6. Rinse sterilizer shelves or loading car and carriage with tap water.

7. Dry sterilizer shelves or loading car and carriage with lint-free cloth(s).

Weekly: **Gravity Type Sterilizer**

Remove chamber drain strainer and flush chamber drain line with hot solution of trisodium phosphate — one ounce (two level tablespoons) to one quart of water.* Follow with a one-quart, hot water flush.

Weekly: **Pre-Vac Type Sterilizer**

Follow manufacturer's equipment manual guidelines for flushing chamber drain line.*

***NOTE:** If trisodium phosphate cannot be used, substitute a solution of AMSCO Sonic Detergent or Liqui-Jet concentrate, 1/2 cup to one quart of hot water.

ETHYLENE OXIDE STERILIZATION AND AERATION

Nonflammable and nonexplosive ethylene oxide gas mixtures are used to sterilize materials which, because of their sensitivity to moisture and/or heat, cannot be sterilized by steam under pressure or dry heat.

Personnel operating ethylene oxide sterilizers and aerators should have completed instruction in all parameters of gas sterilization, aeration, and environmental control of toxic residuals. Responsible supervision should be provided.

• Follow the recommendations of the equipment manufacturer for proper operation and maintenance of the equipment.

• BE SURE VENTILATION/EXHAUST SYSTEM IS WORKING PROPERLY.

Sterilizers and aerators should be installed in an area having at least 10 air changes per hour (as stipulated in most building codes).

Sterilizers should be vented directly to the outside, if a suitable exhaust system is not provided.

Aerators should be vented directly to the outside.

• AVOID DIRECT CONTACT WITH STERILANT OR EXCESSIVE INHALATION OF ITS VAPORS.

When sterilizing cycle is complete, immediately open door, approximately 3-6 inches, leave immediate area of sterilizer, and wait at least 15 minutes before removing load from sterilizer.

Pull loading car; do not push.

Wear protective gloves if processed items must be handled (use loading car whenever possible). Gloves should be removed as soon as possible, and hands washed. Disposable gloves (PVC) should be discarded; cotton gloves aerated and laundered.

• When changing gas cylinders, AVOID CONTACT WITH ANY LIQUID STERILANT THAT MAY REMAIN IN THE CONNECTING LINES AND AVOID PROLONGED OR ACUTE EXPOSURE TO THE GAS VAPOR.

• Gas cylinders (both those in use and those in storage) should be out of the way of traffic and be securely fastened upright. Storage temperature should not exceed 100°F (38°C) in such areas.

• For further information, refer to "Recommendations for Effective Use and Installation of Ethylene Oxide Sterilizers and Aerators," AMSCO Part No. P-62942-091.

WARNING

Items must be aerated following ethylene oxide gas sterilization in order to dissipate the residual gas absorbed by the material. The item manufacturer's recommendation must be followed. In lieu of this information, the following recommended "minimum" aeration times are:

Room Temperature ..... 7 days
Elevated Temperature in an aeration cabinet at 120°F (49°C) ..... 12 hours
Elevated Temperature in an aeration cabinet at 140°F (60°C) ..... 8 hours

HOSPITAL EQUIPMENT AND MATERIALS STERILIZABLE BY ETHYLENE OXIDE

1. Follow the product manufacturer's recommendation for the method of sterilization.

2. Use ethylene oxide gas sterilization when steam sterilization cannot be used due to product being heat sensitive.

LOADING OF ETHYLENE OXIDE STERILIZER

1. Place all packages on edge, on loading car.

2. Place all packages on edge in baskets when sterilizer has no loading car, just shelves.

3. Arrange load so that gas mixture can circulate freely. DO NOT OVERLOAD.

4. Place paper/plastic peel pouch type packages on edge with the plastic side of one facing the paper side of the next.

5. Avoid contact of load components with the walls of the sterilizer chamber.

6. Provide at least three inches of space between the chamber ceiling and the topmost packages of the load.

CONDITIONS REQUIRED FOR ETHYLENE OXIDE STERILIZATION*

Ethylene Oxide Mixture ..... 12% Ethylene Oxide
88% Dichlorodifluoromethane (Freon 12)

Concentration ..... 600-650 milligrams/liter of chamber space

Temperature ..... 130°F ± 5° (54.4°C ± 3°)
100°F ± 5° (38°C ± 3°)

Total Exposure Time ..... 1-3/4 to 6 hours

Relative Humidity 40-80%

*Depending upon sterilizer manufacturer's recommendations.

Caring for Ethylene Oxide Sterilizer

Daily:

1. Wash sterilizer chamber, using a mild detergent solution such as Calgonite®*. Never use strong abrasives, steel wool, etc. A long-handled cellulose sponge mop is helpful in cleaning the longer chambers. CHAMBER SHOULD BE COOL BEFORE CLEANING.

2. Rinse sterilizer chamber with tap water.

3. Dry sterilizer chamber with lint-free cloth(s).

4. Remove chamber drain strainer and free from lint, sediment, etc. — replace.

5. Wash sterilizer shelves or loading car and carriage.

6. Rinse sterilizer shelves or loading car and carriage with tap water.

7. Dry sterilizer shelves or loading car and carriage with lint-free cloth(s).

Weekly:

1. For combination steam/gas sterilizer, keep chamber drain lines clean. See guidelines in Equipment Manual.

DRY HEAT STERILIZATION

Materials and articles which should be sterilized by dry heat include anhydrous oils, powders, petroleum products, heat-stable instruments which cannot be disassembled, sharp instruments which might be damaged by moist heat, and certain glassware. Since dry heat penetrates materials slowly and unevenly, long exposure periods are required.

The equipment used for dry heat sterilization usually consists of a well-insulated chamber, heated by electricity. An electrically-heated dry heat sterilizer may distribute heat either by gravity convection or by mechanical convection (equipped with a blower for forced air circulation). The most efficient equipment for dry heat sterilization is the electrically-heated mechanical convection dry heat sterilizer.

LOADING OF DRY HEAT STERILIZER

1. Never overload the chamber.

2. Allow space between packaged articles and between baskets or containers of supplies.

3. Keep all articles well away from chamber walls, so that the hot air may circulate freely.

MINIMUM STANDARDS FOR DRY HEAT STERILIZATION

There are many varying requirements for dry heat sterilization, depending upon the characteristics of individual items. The following standard exposure conditions in a mechanical convection or gravity convection dry heat sterilizer are suggested:

340°F (170°C) for one hour
320°F (160°C) for two hours

NOTE: These temperature-time recommendations include a reasonable allowance for temperature lag in the load during the initial part of the exposure period.

CONTROL MEASURES FOR DETERMINING THE EFFICIENCY OF STERILIZING PROCESSES (STEAM, ETHYLENE OXIDE, DRY HEAT)

Biological

The best procedure to ascertain the sterility of an article or to determine the efficiency of a sterilizing process is the use of a biological indicator.

The most reliable forms of biological indicators are those which employ dry spores of a species which is resistant to the sterilant being tested. These spores are seeded in known populations on a known surface area and standardized so that a known survival time and kill time can be demonstrated.

RECOMMENDED TYPES OF BIOLOGICAL INDICATORS

STEAM ..... *Bacillus stearothermophilus*

DRY HEAT ..... *Bacillus subtilis (globigii)*

ETHYLENE OXIDE ..... *Bacillus subtilis (globigii)*

FREQUENCY OF TESTING

All steam sterilizers should be biologically monitored at least once a week, preferably daily.

All ethylene oxide and dry heat sterilizers should be biologically monitored every cycle.

AUXILIARY CONTROLS

Mechanical Control

INDICATOR-RECORDER CHART

Steam — Observe chart during and after each cycle to determine if correct time-temperature relationship has been attained and maintained as necessary for each particular sterilizer load.

Ethylene Oxide Gas — Observe chart during and after each cycle to determine if proper pre-vacuum, load conditioning, temperature, exposure time, post vacuums have been attained and maintained as necessary.

Chemical Controls

Sterilizer Tape — Used for securing wrapper/package and as an index of only exposure to the sterilant system.

Steam — Indicates the pack/package was exposed to a certain degree of temperature.

Ethylene Oxide Gas — Indicates the pack/package was exposed to ethylene oxide gas.

Chemical Indicator — Placed in center of pack/package.

Steam — Should indicate physical conditions of temperature, time, and moisture have been reached in that portion of the pack/package.

Ethylene Oxide Gas — Indicates that pack/package was exposed to ethylene oxide gas.

NOTE: CHEMICAL INDICATORS ARE NOT VALID MONITORS OF STERILITY OF PACK OR PACKAGE.

FACTORS ASSOCIATED WITH HUMAN ERROR IN STEAM OR ETHYLENE OXIDE GAS STERILIZATION

1. Failure to observe and understand parameters of sterilizing equipment.

2. Incorrect methods of packaging and wrapping of supplies with no regard for permeability to sterilizing agent or size, weight, and density of pack or packages.

3. Careless loading of sterilizer with disregard for circulation of sterilizing agent.

4. Failure to time correctly the proper period of exposure when required.

5. Failure to carry out the correct sequence of operations in the sterilizing cycle.

6. Lack of basic knowledge concerning principles of operation and care of the sterilizer.

7. Tendency to short-cut because of pressure of work, distraction, or irresponsibility.

8. Attempts to sterilize materials which are impervious to steam or ethylene oxide gas.

9. Antagonistic attitude in place of voluntary cooperation on part of sterilizer operator.

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